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ABSTRACT

This paper suggests that the mathematics teacher needs to do much reading and studying of important trends in improving the mathematics curriculum. Recommendations are made for what teachers need to look for in research studies in mathematics in order to help them recognize what would make for a quality study. Collaborative and individualized approaches are compared and portfolio methods of evaluation and problem solving issues in mathematics instruction are discussed. Issues in preparing a mathematics lesson are also addressed. (ASK)

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# Improving Mathematics Instruction

## by Marlow Ediger

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## IMPROVING MATHEMATICS INSTRUCTION

The mathematics teacher needs to do much reading and studying of important trends in improving the mathematics curriculum. He/she should observe in classrooms to notice what might be used personally to make for an improved set of learning activities for pupils. These activities need to assist pupils to achieve objectives of instruction (Ediger, March, 1995). The mathematics teacher also should notice diverse appraisal procedures to use for diagnosis and remediation. Inservice opportunities should be available for teachers to improve the teaching of mathematics. These inservice opportunities should pinpoint instructional improvement needs within a specific classroom. One approach is to survey research studies and notice what is recommended from these endeavors to make for improvement in teaching and learning.

### Research Studies in Mathematics

Many research studies are made each year to determine what can be done to assist pupils to learn more and to learn it better in mathematics. Sometimes, the research studies are not done professionally and the results are not useful to the mathematics teacher. What should the teacher look for in research studies in mathematics that would make for a quality study? The following, among others, are recommended criteria for experimental studies:

1. The pretest results should indicate that pupils in the control group(s) and the experimental group(s) are equivalent to begin with. If they are not equivalent, then the one group that starts ahead of the others should do better within the innovative approach being used in the experimental group or in the control group using traditional methods of teaching.

2. If a pretest was not used to show equivalency of the groups of pupils used in the study, random sampling for the experimental as well as the control group(s) should be used. Random sampling tends to equate pupils when making initial comparisons between or among the experimental and control group(s).

3. the researcher should use analysis of covariance to equate groups if random sampling has not been used for initial equating the groups in the study. Analysis of covariance is a statistical procedure for equating two or more groups whereby initially, one group was ahead of the other group(s).

4. the pretest and post test should have test results from high quality measurement instruments. These measurement instruments need to be high in validity and reliability. The latest volume of the Mental

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Measurements Yearbook (Oscar Buros, Editor, 1992) provides information on different measurement instruments in terms of validity and reliability. The mathematics teacher needs to realize that there is selected opposition to using standardized tests to measure pupil achievement. In other words, there are additional means available to determine pupil progress in mathematics.

5. there needs to be an adequate number of pupils in each of the groups -- the experimental group using the new innovation versus the control group(s) using traditional procedures of instruction.

6. the research should state, after post test results have been evaluated, if any group did better at the .05 level. If they did do better statistically, were the results important enough to warrant attention by readers of the research study? In other words, were the post test results significantly different to truly warrant saying the innovative approach was better than the traditional approaches of teaching in the control group(s). That is why the .05 level of significance is important as statistical tool. There can be more than one control group using a traditional approach in teaching. Also, there can be more that one experimental group using separate innovate procedures in teaching.

The above are just a few items in noticing the quality of research done. The mathematics teacher may check with a school research specialist to ascertain if a study was done well. The mathematics teacher, in the process, may learn much about doing research and might become involved in the school or school system in conducting research studies.

What if pupils in the experimental group did better at the .05 level as compared to pupils in the control group(s)? Should the teacher think that the innovative procedure needs to be adopted schoolwise? There need to be several research studies that do confirm that one approach in teaching mathematics is better that the others, not just one study.. Then too, there are pupils in the experimental group who did not do as well as the pupils in the control group even though an innovative approach was used in teaching mathematics. This can be noticed when comparing pretest with post test scores of individual pupils in the experimental group.

Research methodology has a long way to go when thinking of improving the quality of studies that need to be done. Thus, there need to be improved measurement devices used to determine pupil achievement in the pretest as well as in the post test. Studies need to be replicated to indicate if an innovative approach truly is better than traditional methods of teaching. The length of time given for the duration of the study as well as the number of pupils used in the study need to be adequate. Should research studies then be eliminated or curtailed. No! More sophisticated studies need to be in the offing. Research needs to

move from where it is presently to where it should be in terms of quality. It is important to remember that pupils are human beings and not automatons. Individuals react differently in different situations, such as in testing environments. There are so many variables to consider when evaluating human beings. One variable, among many others, is that a pupil feels differently at different times. Feelings, in part, make for actions that differ from one person to another. These feelings can vary from one interval of time to another within a person. This can even be a very short interval of time.

### Collaborative Versus Individualized Approaches in Learning

There are numerous journal articles and mathematics teacher education textbooks that extol the virtues of collaborative learning for pupils. These articles/texts make it sound as if all instruction need to stress pupils working together in groups or committees. To be sure pupils should spend some time working collaboratively. Thus, pupils may learn from each other. They may be able to diagnose errors and work toward remediation in a cooperative manner. Peer teaching has much to recommend itself whereby a pupil teaches another learner. Or several pupils pool efforts to engage in problem solving experiences. Being able to work well with others is important in and of itself.

However, there are pupils who like to work individually in ongoing lessons and units of study. This is a preferred learning style of selected pupils. Intrapersonal as compared to interpersonal are two types or styles of learning (Gardner, (1993).

Even if research would say that pupils in collaborative settings do better than those working individually on mathematics lessons, there are always learners in the research study who were in the experimental group having the innovation who do better with individualized procedures in learning mathematics. I recommend rational balance among and between individual versus collaborative efforts on the part of pupils when being involved in the mathematics curriculum. Being able to work well by the self as well as with others are both important.

### Portfolio Methods of Evaluation

A relatively new approach in appraising pupil achievement is to use portfolio procedures. Portfolio use goes beyond that of using test scores to evaluate achievement in mathematics. Traditional approaches have stressed using standardized and criterion referenced test scores largely to show performance of pupils in mathematics. The following are reasons why standardized (norm referenced) test scores are not adequate:

1. It is a one shoot approach in appraising pupil achievement in mathematics. Thus, these tests are usually given once a year in the evaluation process. If a pupil is not at his/her best at that time, tough cookies.

2. these tests are written deliberately to spread pupils out on a wide range form the 99th down to the first percentile. A built in procedure was worked out in pilot studies to obtain this spread of scores.

3. the tests may not be valid in that there are no objectives provided that indicate what needs to be taught for pupils to be successful on the standardized test.

4. test results compare one pull with another instead of determining if objectives in the mathematics curriculum have been obtained.

5. teachers may not see what pupils have missed on the standardized test. It is important for teachers to be aware of what pupils did not do well in so that remediation activities can take place.

Criterion referenced tests (CRTs) also have their weaknesses. Teachers do have the objectives to use to teach toward. This is an advantage over that of standardized tests. Then too, pupils are appraised on tests against the objectives stated for the CRTs. Instructional procedures are then valid; what has been taught is then measured with the CRT. There are, however, the following disadvantages of CRTs:

1. It too is a one shoot approach in determining pupil achievement in that one test is to convey much information about a learner's progress within an interval of time.

2. also, if a pupil does not feel well physically or emotionally at test taking time, too bad!

3. verbal intelligence only, is being measured. Thus, reading and responding to multiple choice test items is usually in the offing.

4. if tests are timed, selected pupils work more slowly than do others and may not complete taking the test.

5. the CRTs might not have been pilot studied and may have numerous weaknesses in validity and reliability.

Does this mean that standardized and criterion referenced tests should not be given? The answer is they should be given, especially when high validity and reliability of these tests is in evidence. Test results, including teacher written tests, should become an inherent part of the portfolio for a pupil.

Portfolios should not become too voluminous. Careful selection of items should be a part of the portfolio. These items include the following:

1. a table of contents indicating the order of contents in the portfolio.

2. a statement of pupil purpose in placing the chosen items in the portfolio.

3. a random selection of daily work completed by the pupil.

4. snapshots of models made in mathematics.

5. videotape of the learner's participation in committee and large

group instruction.

6. tape recordings of book reports given pertaining to content on mathematics.

7. personal pupil paper on what goals he/she needs to work on in mathematics.

8. self evaluation by the pupil pertaining to what has been accomplished in mathematics.

9. listing of individual projects completed by the involved pupil.

10. teacher complete checklists, rating scales, observations, and journal entries (Ediger, December, 1995).

The portfolio is an excellent device to use in reporting pupil progress to parents. Here, the pupil may point out specific items of achievement in the portfolio to parents. There are good opportunities to discuss with parents pupil progress using the portfolio as a basis. Actual products as well as possesses of pupil work may be viewed and assessed. Pupil input is inherent when being there to discuss portfolio results. Parents may raise questions about the involved learner's progress. Sometimes, school administrators attend the parent/teacher conference whereby they may discuss pupil progress with the teacher, the pupil, and parents. Diagnosis may be stressed followed by remediation suggestions. The purpose of the conference is to guide each pupil to achieve as much as possible. Pooling of ideas may be an excellent way of assisting pupils to do well in school.

## Determining Present Achievement Levels in Mathematics

The mathematics teacher needs to be a keen observer of present achievement levels of each pupil to determine sequence in ongoing learning opportunities. By observing each pupil carefully and recording observations made, the teacher may notice where specifically the pupil is achieving at the present time. A philosophy of constructivism is involved in that contextual observations are being made within the lesson that the pupil is working on. Examples will be given of pupils on diverse grade levels to notice observations made by teachers.

Miss Smith, a first grade teacher, is helping her pupils to add using a hands on approach in learning. Miss Smith has demonstrated with the use of large sticks what a set of three is as well as a set of five. She asked pupils to show with the smaller sticks at each desk what a set of three sticks are on their desk tops. Each pupil's results are carefully monitored by the teacher. Next, each pupil is to show a set of five sticks. Miss Smith notices the following pertaining to pupil's arranging the correct number of sticks:

1. a few pupils are hesitant in their work.
2. two pupils look at how others are arranging their sticks before working on their own.
3. four pupils are lost in knowing what to do.
4. five pupils find the work relatively easy to do.

5. the rest of the twenty-five pupils probably are working on their present achievement level.

Ms. Smith has learned rather immediately that pupils are at different places in achievement and individual differences need to be provide for. This may mean individual help for some to achieve more optimally, such as those not knowing what to do in the above named lesson. Others will need more challenging work in mathematics such as the five pupils who found the work to be too easy. Peer teaching may help some to catch up with the higher achievers. Collaborative work within committees might well assist continuous progress for those working on their present achievement level. Good sequence should follow in mathematics instruction whereby each pupil achieves sequential success in learning.

Mr. Brown, a fourth grade teacher, is teaching a lesson on problem solving in mathematics. Each pupil is asked to develop a problem which requires thought and deliberation. He had presented models as examples for pupils, the day before. There were a few pupils who asked to be able to work together with peers in a collaborative setting. In an atmosphere of respect, the pupils identified the problem, developed an hypothesis, tested the hypothesis in a lifelike situation, and revised the hypothesis if necessary (Ediger, Philosophy in Curriculum Development, 1995). During the class session, pupils with teacher guidance worked on the following:

1. clarifying each problem written so it was meaningful.
2. noticing what the problem focuses on that needs to be solved.
3. selecting information in answer to the problem.
4. thinking critically about the information gathered to notice its relevance and accuracy.
5. noticing how hypotheses are tested.
6. indicating how an hypothesis is revised, when necessary.

By following the discussion involving problem solving, Mr. Brown obtained information on where each pupil was presently achieving in the area of problem solving. He recorded in his journal what needs to be done to guide each pupil to become more knowledgeable about problem solving. Based on diagnosis, Mr. Brown was able in the next daily lesson in mathematics to clarify necessary information that pupils need, to make for better sequence in learning about problem solving in mathematics.

There have been numerous ways that mathematics educators have devised to ascertain present pupil levels of individual achievement in mathematics. It is very important to begin teaching with where pupils are individually in achievement now, before moving on to new objectives

to be attained.

Behaviorism, as a psychology of learning, emphasizes the use of pretesting based on the objectives of the new teaching unit to be implemented. Test items on the criterion referenced test are to be written pertaining to each stated objective. Based on pretest results from each pupil, the teacher might then have a better perspective as to where specifically each child is to begin with in instruction in the new unit of study in mathematics.Behaviorism has a rather long history of advocating the methods of science whereby objectivity is stressed in measuring pupil achievement in teaching and learning (Thayer, 1970). The following are objectives stated very specifically so that, with teaching, the teacher may measure if pupils have or have not been successful in achieving objectives:

1. Given eight sticks, the pupil will arrange two sets, one containing three members and the other containing five members.
2. Pupils will combine the set of three and the set of five to make a new set of eight.
3. Pupils will change the order of the two sets, the first containing five and the second set three members (commutative property) to indicate and verify a set of eight.

The teacher then teaches so that pupils might achieve each behaviorally stated objective. Following the instructional activities, the teacher measures how many pupils achieved each objective in sequence. Objectives not achieved will need additional teaching and, perhaps, a new instructional strategy.

The concept performance objectives is used frequently in the literature on teaching mathematics. Basically, performance objectives equal behaviorally stated objectives. The two are quite synonymous. A minor difference involves performance objectives stressing an activity centered or hands on approach in teaching and learning, such as in the following examples:

1. Given four different wooden geometrical figures in a set of twenty, the pupil will sort these in terms of being squares, rectangles, circles, and triangles wit 100 per cent accuracy.
2. Given an adequate number of sticks, the pupil will arrange these in terms of all possible sets whose addends equal ten.

Not all behaviorally stated objectives stress an activity centered approach such as in the following:

1. Given ten basic number pairs, the pupil will add these with 90 per cent accuracy. These number pairs involve drill and practice such as 2+3= , 4+5= , 5+4= , 3+2= , and so on.
2. The pupil will write answers to fifteen sets of one digit subtraction number pairs with 100 per cent accuracy. Here, the pupil responds to sets in subtraction such as in the following:

8-6= , 7-4= , 6-5= , 9-7= , 5-4= , 9-6= , 8-3= , 6-2= .

Somewhat toward the other end of the continuum, advocates of problem solving strategies of teaching believe that pupils reveal where they are presently in achievement by participating in identifying and solving problems within a contextual situation. Learners here are rather heavily involved in choosing problems and working toward their solution. Sequence in learning resides within the pupil, rather than being external to the learner. In contrast, behaviorism emphasizes that pupils achieve sequential objectives determined outside the framework of pupil involvement in given learning opportunities. These behaviorally stated objectives might be determined completely by the teacher and/or by the state department of education.

With problem solving as a major goal of instruction, the objectives will tend to be open ended and general, not specific. Within a learning opportunity such as viewing a video tape, pupils will identify problems in a stimulating environment. It is difficult to know ahead of time what the problem will be. Information gathered, also with teacher guidance, might involve choosing sources from a variety of materials located in the school setting. The hypothesis, or answer, to the problem should follow data gathering. Again, a variety of learning opportunities will be necessary to check the hypotheses by testing it in a lifelike setting. A strict behaviorist may respond by saying that the objectives in problem solving might be stated behaviorally and in measurable terms, such as in the following:

1 The pupil will identify a problem.

2. The pupil will gather information in answer (develop an hypothesis) to the problem.

3. The pupil will test the hypothesis in a lifelike situation.

Actually, when problem solving is stressed, the steps in one, two, and three above are inherent, and do not need stating. To be sure, there are different models to use in problem solving and the involved steps may be more numerous in one method as compared to the other. I would say, however, the following flexible steps should be involved in all problem solving situations:

1. identifying a problem in a contextual situation, meaning within an ongoing learning opportunity.

2. securing information to obtain an hypothesis.

3. evaluating the hypothesis in a realistic situation, not through paper/pencil testing.

4. additional flexible steps may be added to indicate a model for pupils to emulate, such as thinking critically and creatively about the information secured to develop an hypothesis. Otherwise, problem solving indicates there are problems that need solutions. Some

problems are relatively easy to solve whereas others take much time to find solutions. One criterion needs adding here and that is deliberation is necessary with problem solving activities. If a pupil knows that three plus five is equal to eight, then there is no problem to solve because answers here are found routinely from previous teaching as well as from rote learning and memorization.

### Inductive and Deductive Thinking

There have been many debates involving inductive thought as compared to deductive approaches in teaching mathematics. I would say that both approaches need to be used. For example in problem solving, the learner with teacher guidance starts with inductive thinking. Thus, when a problem is selected within an ongoing lesson or unit of study, the learner begins with specifics, that is a specific problem. Next, information is gathered in ways to develop an hypothesis. The information is gathered from specific cases, knowledge, and data. After adequate specific information has been acquired, generalizations are developed. This started with specifics and ended up with a broader generalization, an inductive approach. The broad or broader generalization actually amounts to an hypothesis. Then deductive thinking is used in that the pupil applies the broad generalization to specific cases; from the general to the specific is then being stressed.

When teaching a lesson in mathematics outside the framework of problem solving, the teacher may use both inductive as well as deductive teaching and thinking. If the teacher presents a model for pupils to emulate such as placing three sticks in one set and five in the other, deduction is involved. Thus, pupils have applied what the teacher explained with model sticks used in teaching. From the general to the specific was being emphasized. The teacher presented the generalization while the pupils then specifically emulate what had been presented by the teacher.

There are ample opportunities to use both approaches in teaching and learning mathematics. When teachers explain a new process in mathematics to pupils, deduction is being emphasized. Concrete (objects and items) and semi concrete materials(pictures, videotapes, films, filmstrips, and slides) might be used to teach pupils. Explanations and short lectures may be used along with the teaching materials mentioned above.

Inductive teaching or learning by discovery may also emphasize using concrete and semi concrete materials. For example in teaching very young children when readiness is in evidence, the teacher may have pupils place three sticks in one set and five in the other followed by having learners indicate what the answer is when the two sets are combined. Pupils here are to learn by discovery, not having experienced this specific learning activity previously. Pupils are to generalize on what three plus five is from a specific case (Ediger, 1997).

## Unit Teaching in Mathematics

It is vital that teachers plan each mathematics unit of study carefully. A team approach may be used here in that members may plan together. There are certain essential parts of a unit plan that need to be incorporated into a teaching unit. First, there should be a statement of philosophy of teaching. Why? The philosophy decided upon provides guidance and direction in teaching mathematics. Teachers need to study and analyze different philosophies of teaching to come up with one that harmonizes with the beliefs of the individual teacher as well as the school and harmonizes with modern methods of instruction. The following philosophies might well be considered carefully prior to choosing the one to adopt:

1. a problem solving approach whereby lifelike problems are stresses n the curriculum.
2. a subject matter philosophy whereby vital facts, concepts, and generalizations are taught and learned.
3. a decision making philosophy whereby pupils learn to choose activities from among alternatives, such as in the use of learning centers.
4. a behavioristic philosophy/psychology whereby pupils achieve predetermined objectives.

One or more philosophies may be selected for implementation in the mathematics curriculum. Quality objectives, learning opportunities, and appraisal procedures need to be in the offing. Pupils need to achieve as optimally as possible.

Based on one's philosophy of teaching, objectives for pupils to achieve are chosen. There needs to be three categories of objectives. The first, knowledge objectives, stresses facts, concepts, and generalizations that pupils are to attain. The following are examples:

1. pupils will know what is meant by addends, sum, minuend, subtrahend, and difference.
2. pupils will indicate the meanings of interest, principal, dividends, insurance, and stocks.

Skills objectives need to be stressed in teaching in that knowledge is then put to functional use. The following are skills objectives:

1. pupils will develop creative solutions to three word problems.
2. pupils will analyze data in terms of being factual versus opinions.

In addition to knowledge and skills objectives, attitudinal goals are equally important. Good attitudes toward mathematics assist pupils to do better in attaining knowledge and skills objectives. I maintain that pupils who have good attitudes toward the study of mathematics will achieve as well as possible, in most cases. Unwholesome attitudes certainly do

hinder learners from achievement in general. If these negative attitudes are in evidence in mathematics, the chances are pupil achievement will falter. The following are examples of attitudinal objectives for pupils to achieve:

1. the pupil will have an inward desire to do the best possible to achieve optimally in mathematics.
2. the pupil will value the study of mathematics for its own sake as well as for practical reasons.

Each objective listed for teaching an entire unit needs to be carefully chosen and clearly written. This section is indeed very vital in that it states what will be taught to pupils.

The objectives section in a teaching unit should contain all that will be emphasized in the entire unit of study which may last from two to four weeks. Younger pupils will have units that are shorter in duration, such as two weeks, as compared to four weeks for older pupils. These are approximate lengths of/for unit teaching. The teacher needs to study pupils to determine the interests possessed in an ongoing unit in terms of duration. Units can be shortened and lengthened when observing the interests of learners. Then too, pupil purpose needs to be developed and maintained by the teacher. A skilled, knowledgeable teacher may increase duration of interests as well as pupil purpose for learning in mathematics. Pupil interests and purpose for learning will become more important when discussing learning opportunities to achieve objectives. Which learning opportunities should then be in evidence in a teaching unit?

1. realia, objects, and items which involve use of the five senses. For example, concrete materials which may be used to count, add, subtract, multiply, and divide should be readily available. Models of geometrical plane figures such as squares, rectangles, triangles, circles, and parallelograms should be at the finger tips of the teacher and pupils to use in teaching and learning. Additional models may include cubes, rectangular solids, pyramids, cones, cylinders, and triangular solids. As the teacher continues to teach, he/she will develop a repertoire of what materials of instruction are good to have available. I have observed many student teachers and cooperating teachers who made models of plane and solid geometrical figures to use in teaching mathematics. These teachers also collected many objects, items, and realia to use in teaching the basic four operations. These included beads, seeds, and buttons. Then too, materials used in everyday teaching may also be used such as pencils, crayons, paper clips, and strips of paper.
2. semiconcrete materials of instruction to used in unit teaching include pictures, films, videotapes, slides, filmstrips, CD ROMS, computer packages, and study prints.
3. abstract materials of instruction in mathematics may include

reading, writing, discussions, cassette tapes, and drawings as learning opportunities in unit teaching.

Learning opportunities must be selected carefully to provide for the interests, needs, and purposes of individual learners.
They need to be clearly written down so that a substitute teacher, if necessary, may also be able to use these devices for instruction.

The scope of the unit should be defined carefully. Scope refers to the breadth of content to be covered in the chosen unit of instruction. Thus, the unit might deal with a study of addition. To broaden the scope, the unit may then include the inverse operation of subtraction or even be broader in scope to include multiplication and division of whole numbers. Sequence in the mathematics unit also needs to be defined. A logical sequence stresses the teacher ordering the learning opportunities for pupils to pursue so that objectives might the achieved. A psychological sequence stresses pupils selecting the order of learning opportunities to pursue sequentially, such as at learning centers. A combination of the two approaches might also be used, such as in an eclectic philosophy of teaching.

The evaluation section of the teaching unit should have the appraisal procedures spelled out clearly. If tests are used, they should be written out just as if they are to be used. Teacher written tests such as true-false, multiple choice, completion, matching and essay, should be written in detail. The same is true for the following which might be used as evaluation techniques:

1. teacher observation. Write the criteria that will be used here to observe and record selected learner's progress, at random, daily and throughout the entire unit of study.
2. checklists. Write the standards to be used in the checklist to mark if a pupil has or has not measured up to that standard.
3. rating scale. List the standards to be used, and after each rate a child from 1 to 5 on personal strengths possessed.
4. standardized test(s). Indicate the name of the test, include validity and reliability data.
5. criterion referenced test (CRT), include validity ad reliability data.
6. diary entries. Indicate date of entry and record in a sentence or two what a pupil (provide name) had achieved.
7. journal writing. Write several paragraphs indicating what was covered in a lesson and describe specific problems encountered by pupils individually.
8. log entries. Summarize the diary entries to indicate achievement of pupils and remedied errors, within a period of a week.
9. write evaluation criteria by which pupils may appraise the self.

10. write evaluative criteria for the teacher to appraise the self in teaching.

This section can take much time in writing since the evaluation devices need to be completed in their entirety, excepting numbers 4 and 5 which have already been written.

## The Daily Lesson Plan

From the unit plan discussed above, the teacher may choose which objectives to emphasize on a particular day. The teacher may even think of and use modifications from those listed in the unit plan. The objectives chosen should reflect what pupils need to achieve optimally. Individual differences need adequate attention in that pupils individually are at different levels of achievement. The teacher should never forget the interests of pupils in choosing objectives since obtaining pupil attention for learning is paramount.

Learning opportunities selected from the unit plan need to be valid to achieve the stated objectives. The learning opportunities should be chosen with great care so that engaged pupils develop an inward desire to learn.

Evaluation techniques selected need to appraise if pupils achieved the stated objectives. Each technique chosen should be valid in that it measures what has been taught in terms of the stated objectives emphasized. Reliability is salient in that the measurement device selected should appraise pupil achievement in a consistent manner.

The daily lesson plan is a very specific device since it is to be implemented directly in teaching a specific set of pupils.

## Conclusion

The mathematics teacher needs to plan carefully each lesson used in daily teaching. The ideas for the lesson plan come from the unit plan which may cover what is to be taught for several weeks. Careful planning is necessary so that pupils individually may learn as much as possible. Pupils' needs, interests, and purposes need to be emphasized in unit construction and daily teaching.

Issues in teaching mathematics need to be considered diligently and resolved to make for a quality curriculum.

## References

Buros, Oscar (Editor), The Mental Measurements Yearbook. New York: The Gryphon Press.

Ediger, Marlow (1995), "Current Concepts in Teaching Mathematics," Philippine Education Quarterly, 24 (3), 7-20.

Ediger, Marlow (1995), "The Psychology of Learning and the Teacher," Philippine Education Quarterly, 23 (4), 1-11.

Ediger, Marlow (1995), Philosophy in Curriculum Development.

Kirksville, Missouri: Simpson Publishing Company, 88.

Ediger, Marlow (1997), Teaching Mathematics in the Elementary School. Kirksville, Missouri: Simpson Publishing Company, 78-92.

Gardner, Howard (1993), Multiple Intelligences: Theory Into Practice. New York: The Basic Books.

Thayer, V. T. (1970), Formative Ideas in American Education. New York; Dodd, Mead, and Company, 224.